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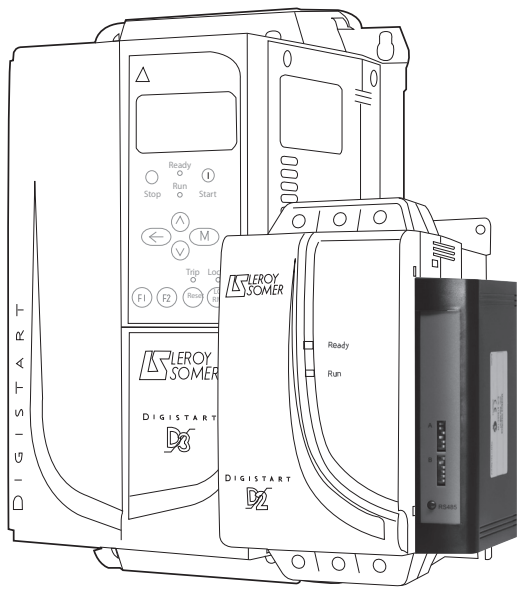
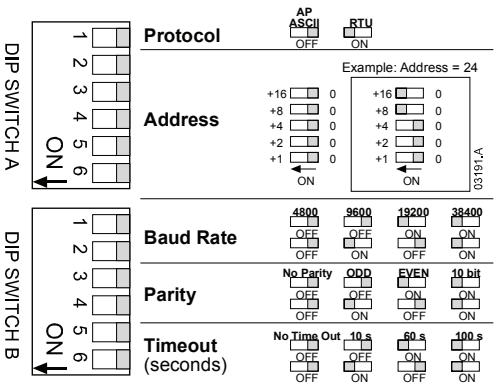


This manual is to be given to the end user



MODBUS MODULE

Communications module

User Guide

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional parameters of the equipment or from mismatching the starter with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the content of the guide without notice.

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1. Introduction

The Modbus Module can be used with Digistart D2 and Digistart D3 soft starters to allow the starter to be connected to a serial communications network using the Modbus RTU or AP ASCII protocols.

2. Important User Information

Observe all necessary safety precautions when controlling the soft starter remotely. Alert personnel that machinery may start without warning.

It is the installer's responsibility to follow all instructions in this manual and to follow correct electrical practice.

Use all internationally recognised standard practice for RS-485 communications when installing and using this equipment.

3. Installation

CAUTION

Remove mains and control voltage from the soft starter before attaching or removing accessories. Failure to do so may damage the equipment.

3.1 Installation Procedure

1. Remove control power and mains supply from the soft starter.
2. Attach the module to the soft starter as illustrated.
3. Apply control power to the soft starter.

3.2 Physical installation

1. Fully pull out the top and bottom retaining clips on the module.
2. Line up the module with the comms port slot.
3. Push in the top and bottom retaining clips to secure the module to the starter.

Figure 3-1 Attach the module to the starter

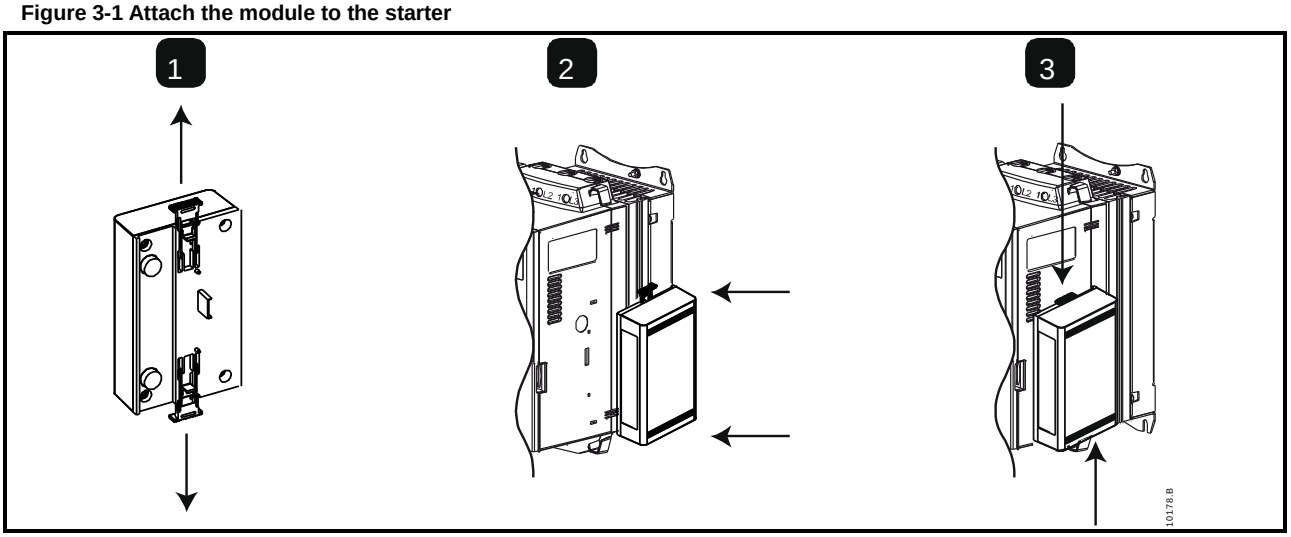
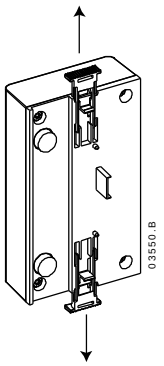


Figure 3-2 Remove the module from the starter

Remove the module using the following procedure:

1. Take the module off-line.
2. Remove control power and mains supply from the soft starter.
3. Disconnect all external wiring from the module.
4. Fully pull out the top and bottom retaining clips on the module.
5. Pull the module away from the soft starter.

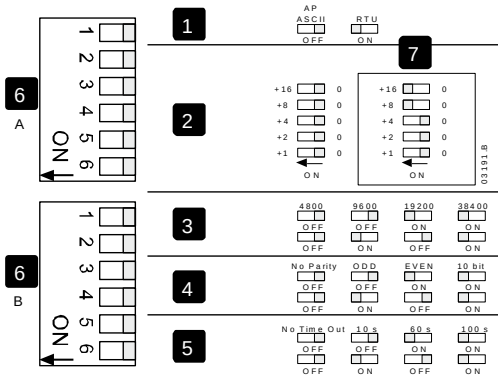


4. Modbus Module Connection and Configuration

4.1 Adjustment

Network communication parameters must be set on the Modbus Module. DIP switch settings take effect on the power-up of the Modbus Module via the soft starter.

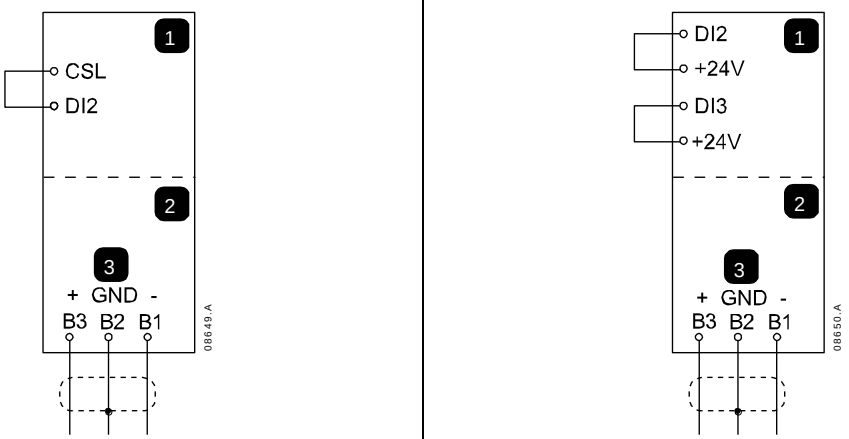
Figure 4-1 Adjustment switches



1	Protocol
2	Address
3	Baud rate
4	Parity
5	Timeout (seconds)
6	DIP switch
7	Example: Address = 24

4.2 Connection

Figure 4-2 Modbus Module connections



1	Digistart D2 CSL, DI2: Stop input	1	Digistart D3 (Remote mode) DI2, +24V: Stop input DI3, +24V: Reset input
2	Modbus Module – RS-485 serial port	2	Modbus Module – RS-485 serial port
3	RS-485 connection onto Modbus network	3	RS-485 connection onto Modbus network

Digistart D2: For the Modbus Module to accept serial commands, a link must be fitted across terminals CSL-DI2 on the soft starter.

Digistart D3: Input links are required across the stop and reset inputs if the soft starter is being operated in Remote mode. In Local mode, links are not required.

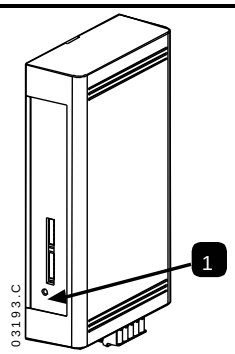
If the Starter Disable function is not required, change the setting of Pr 3A or connect a link across DI4, +24V.

NOTE Digistart D3: Control via the serial communication network is always enabled in local control mode, and can be enabled or disabled in remote control mode (Pr **3O** *Comms in Remote*). See the soft starter user manual for parameter details.

4.3 LEDs

The Network Status LED (1) indicates the state of the communications link between the module and the network. LED operation is as follows:

Figure 4-3 Feedback LEDs



1	Off	No connection or soft starter not powered up
	On	Communication active
	Flashing	Communication inactive

NOTE If communication is inactive, the soft starter may trip if the Communications Timeout function has been set on the module. When communication is restored, the soft starter will require a Reset.

5. Master Configuration

For standard Modbus 11-bit transmission, the Master must be configured for 2 stop bits with No Parity and 1 stop bit for odd or even parity.

For 10-bit transmission, the Master must be configured for 1 stop bit.

In all cases, the Master baud rate and slave address must match those set on the Modbus Module DIP switches.

The data polling interval must be long enough for the module to respond. Short polling intervals may cause inconsistent or incorrect behaviour, particularly when reading multiple registers. The recommended minimum polling interval is 300 ms.

6. Modbus Functions

The Modbus Module supports the following Modbus functions:

- 03 Read multiple registers
- 06 Write single register
- 16 Write multiple registers

Modbus broadcast functions are not supported.

Digistart D2 soft starters (including Remote Keypad):

- Read multiple registers 40003 to 40008
- Write single register 40002

Digistart D3 soft starters:

- Read multiple registers starting from 40003 up to a maximum of 119 register blocks.
- Single write register 40002 or multiple write registers 40009 to 40599.

NOTE A multiple read across register boundary 40008/40009 will result in a Modbus Error code 05 at the Master.

6.1 Modbus Register

NOTE Some soft starters do not support some functions.

Registers 40600 and above are not compatible with Digistart D2 Series soft starters. For Digistart D2, use registers 40002 to 40008.

Table 6-1 Register addresses

Register	Description	Bits	Details
40002	Command (single write)	0 to 2	To send a command to the starter, write the required value: 1 = Start 2 = Stop 3 = Reset 4 = Quick stop (coast to stop) 5 = Forced communication trip 6 = Start using Parameter Set 1 [1] 7 = Start using Parameter Set 2 [1]
		3 to 7	*Reserved*
40003	Starter state	0 to 3	1 = Ready 2 = Starting 3 = Running 4 = Stopping (including braking) 5 = Restart delay (including temperature check) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		4	1 = Positive phase sequence (only valid if bit 6 = 1)
		5	1 = Current exceeds FLC
		6	0 = Uninitialised 1 = Initialised
		7	0 = Remote Operator communications are OK 1 = Remote Operator/Communications device fault
40004	Trip code	0 to 7	See Trip Codes on page 9
40005 [2]	Motor current	0 to 7	Average 3-phase motor current (A)
40006	Motor temperature	0 to 7	Motor 1 temperature (thermal model)
40007	Product information	0 to 2	Product parameter list version
		3 to 7	Product type code [3]
40008	Serial Protocol Version	0 to 7	Communication protocol between module and starter
40009 [4]	Parameter management Single or multiple read or write	0 to 7	Manage soft starter programmable parameters.
40600	Version	0 to 5 6 to 8 9 to 15	Binary protocol version number Parameter list version number Product type code [3]
40601	*Reserved*		
40602 [5]	Changed parameter number	0 to 7 8 to 15	0 = parameters not changed 1 to 255 = index number of the last parameter changed Total number of parameters available in the starter
40603 [5]	Changed parameter value	0 to 13	Value of the last parameter that was changed, as indicated in register 40602
		14 to 15	*Reserved*
40604	Starter state	0 to 4	0 = *Reserved* 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check, run simulation, input A (DI4, +24V) not shorted) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Unintialised 1 = Initialised

Register	Description	Bits	Details
		7	0 = Local control 1 = Remote control
		8	0 = Parameter(s) have changed since last parameter read 1 = No parameters have changed [5]
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	See Trip Codes on page 9 [6]
40605 [2]	Current	0 to 13 14 to 15	Average rms current across all three phases *Reserved*
40606	Current	0 to 9 10 to 15	Current (% motor FLC) *Reserved*
40607	Motor temperature	0 to 7 8 to 15	Motor 1 thermal model (%) Motor 2 thermal model (%)
40608 [7]	Power	0 to 11 12 to 13 14 to 15	Power Power scale *Reserved*
40609	% Power factor	0 to 7 8 to 15	100% = power factor of 1 *Reserved*
40610	Voltage	0 to 13 14 to 15	Average rms voltage across all three phases *Reserved*
40611 [2]	Current	0 to 13 14 to 15	Phase 1 current (rms) *Reserved*
40612 [2]	Current	0 to 13 14 to 15	Phase 2 current (rms) *Reserved*
40613 [2]	Current	0 to 13 14 to 15	Phase 3 current (rms) *Reserved*
40614	*Reserved*		
40615	*Reserved*		
40616	*Reserved*		
40617	Parameter list version	0 to 7 8 to 15	Parameter list minor revision Parameter list major version
40618	Digital Input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start 1 = Stop 2 = Reset 3 = Input A 4 = Input B 5 = Input C, if fitted 6 = Input D, if fitted 7 to 15 = *Reserved*
40619 to 40631	*Reserved*		*Reserved*

[1] Ensure that the programmable input is not set to Motor Set Select before using this function.

[2] For models D3-1x-0053-B and smaller this value will be 10 times greater than the value displayed on the keypad.

[3] Product type code:

4 = Digistart D2
8 = Digistart D3

[4] See the relevant soft starter literature for a complete parameter list. The first product parameter is always allocated to register 40009. The last product parameter is allocated to register 40XXX, where XXX = 008 plus total number of available parameters in the product.

[5] Reading register 40603 (Changed parameter value) will reset registers 40602 (Changed parameter number) and 40604 (Parameters have changed). Always read registers 40602 and 40604 before reading register 40603.

[6] Bits 10 to 15 of register 40604 report the soft starter's trip or warning code. If the value of bits 0 to 4 is 6, the soft starter has tripped. If bit 5 = 1, a warning has activated and the starter is continuing to operate.

[7] Powerscale functions as follows:

0 = multiply Power by 10 to get W
1 = multiply Power by 100 to get W
2 = Power is represented in kW
3 = multiply Power by 10 to get kW

NOTE If Pr **3A** *Input A Function* for Digistart D3 is set to motor set select, this will cause a conflict with motor set selection via serial communications.

6.2 Trip Codes

Table 6-2 Trip messages

Trip Code	Description	Digistart D2	Digistart D3
1	Excess start time	●	●
2	Motor overload (thermal model)	●	●
3	Motor thermistor	●	●
4	Current imbalance	●	●
5	Frequency (Mains supply)	●	●
6	Phase sequence	●	●
7	Instantaneous overcurrent		●
8	Power loss / Power circuit	●	●
10	Heatsink overtemperature		●
11	Motor Connection Tx		●
12	Input trip		●
13	FLC too high (FLC out of range)		●
14	Unsupported option (function not available in inside delta)		●
15	Starter communication (between module and soft starter)	●	●
16	Network communication (between module and network)	●	●
17	Internal fault x (where x is the fault code detailed in the table below)		●
20[1]	Ground fault		●
23	Parameter out of Range		●
24	Input B trip		●
26	L1 phase loss		●
27	L2 phase loss		●
28	L3 phase loss		●
29	L1-T1 shorted		●
30	L2-T2 shorted		●
31	L3-T3 shorted		●
32	Motor 2 overload (thermal model)		●
33[2]	Time-overcurrent (Bypass overload)	●	●
35	Battery/clock		●
36	Thermistor circuit		●
37	*RTD/PT100 A*		●
38[1]	*RTD/PT100 B*		●
39[1]	*RTD/PT100 C*		●
40[1]	*RTD/PT100 D*		●
41[1]	*RTD/PT100 E*		●
42[1]	*RTD/PT100 F*		●
43[1]	*RTD/PT100 G*		●
45	RTD/PT100 X Circt		●
46	Analog input trip		●
47	Overpower		●
48	Underpower		●
255	No trip	●	●

[1] Available with Digistart D3 only if the appropriate option card is fitted.

[2] For Digistart D3, time-overcurrent protection is only available on internally bypassed models.

6.2.1 Internal Fault x

The table below details the internal fault code associated with trip code 17.

Table 6-3 Internal fault X

Internal fault	Message displayed on the keypad
70 to 72	Current Read Err Lx
73	ATTENTION! Remove Mains Volts
74 to 76	Motor Connection Tx
77 to 79	Firing Fail Px
80 to 82	VZC Fail Px
83	Low Control Volts
84 to 98	Internal fault X Contact your local supplier with the fault code (X).

6.3 Cyclic redundancy check (CRC)

The CRC is a 16bit cyclic redundancy check using a polynomial with a value A001.

The 16bit CRC is appended to the message and transmitted LSB first.

The CRC is calculated on all the bytes in the frame.

For further Modbus information, including the CRC calculation, refer to the Modbus protocol specifications available at http://www.modbus.org/specs.php.

6.4 Examples

Command: Start

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	06	40002	1	CRC1, CRC2
Out	20	06	40002	1	CRC1, CRC2

Starter status: Running

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	03	40003	1	CRC1, CRC2
Out	20	03	2	xxxx0011	CRC1, CRC2

Trip code: Motor overload

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	03	40004	1	CRC1, CRC2
Out	20	03	2	00000010	CRC1, CRC2

Download parameter from starter
Digistart D3: Read parameter 3 (Pr **1C**) *Locked Rotor Time*, 10 seconds

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	03	40011	1	CRC1, CRC2
Out	20	03	2	10	CRC1, CRC2

Upload parameter to starter
Digistart D3: Write parameter 12 (Pr **2H**), *Stop Mode*, set = 2 'Adaptive Control'

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	06	40020	2	CRC1, CRC2
Out	20	06	40019	2	CRC1, CRC2

Upload multiple parameters to starter
Digistart D3: Write Parameters 6, 7, 8 (Prs **2B** *Current Limit*, **2C** *Initial Current*, **2D** *Start Ramp Time*). Set to values of 350%, 300%, 15 seconds respectively.

Message	Starter Address	Function Code	Register Address	Data	CRC
In	20	16	40014,3	350, 300, 15	CRC1, CRC2
Out	20	16	40014,3	350, 300, 15	CRC1, CRC2

NOTE This function can only be used to upload consecutive parameters. The Register Address data indicates the number of parameters to be uploaded, and the register address of the first parameter.

NOTE Parameter information can only be uploaded/downloaded from Digistart D3 starters.

6.5 Modbus Error Codes

Table 6-4 Error codes

Code	Description	Example
01	Illegal function code	Function other than 03 or 06
02	Illegal data address	Register number invalid
03	Not readable data	Register not allowed for data reading
04	Not writable data	Register not allowed for data writing
05	Data boundary fault	Multiple data transfer across data boundary or data size more than 125
06	Invalid command code	eg writing "6" into 40003
07	Illegal parameter read	Invalid parameter number
08	Illegal parameter write	Invalid parameter number, read only, or hidden parameter
09	Unsupported command	Sending a serial command to Digistart D3 with Pr **3O** = Disable Control in RMT.
10	Local communication error	Communication error between Modbus slave and starter

NOTE Some of the above codes are different from those defined in the Modbus Application Protocol Specification available on www.modbus.org.

7. Modbus Control via Remote Keypad

The Modbus Module can be used to connect a Remote Keypad to the soft starter, enabling control via an RS-485 serial communications network. See the Remote Keypad instructions for details.

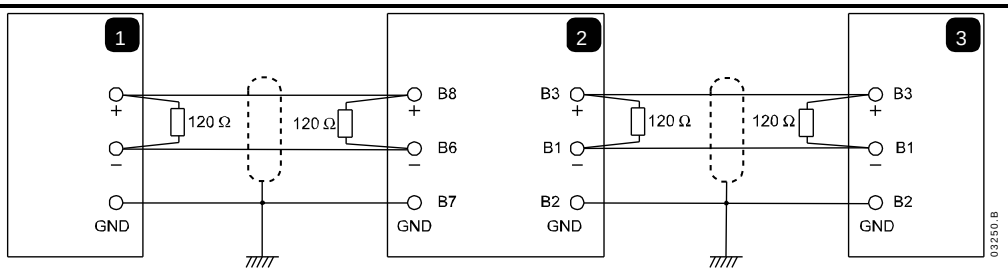
7.1 Grounding and Shielding

Twisted pair data cable with ground shield is recommended. The cable shield should be connected to the GND device terminal at both ends and one point of the site protective ground.

7.2 Termination Resistors

In long cable runs prone to excessive noise interference, termination resistors should be installed between the data lines at both ends of the RS-485 cable. This resistance should match the cable impedance (typically 120 Ω). Do not use wire wound resistors.

Figure 7-1 Installation with termination resistors



1	Network master RS-485
2	Remote Keypad RS-485
3	Soft starter RS-485

7.3 RS-485 Data Cable Connection

Daisy chain connection is recommended. This is achieved by parallel connections of the data cable at the actual device terminals.

7.4 Remote Keypad RS-485 Network Connection Specifications

Input impedance: 12 kΩ
Common mode voltage range: - 7 V to + 12 V
Input sensitivity: ± 200 mV
Minimum differential output voltage: 1.5 V (with max loading of 54 Ω)

8. Specifications

Enclosure

Dimensions ..... 40 mm (W) x 166 mm (H) x 90 mm (D)
Weight ..... 250 g
Protection IP20

Mounting

Spring-action plastic mounting clips (x 2)

Connections

Soft starter ..... 6-way pin assembly
Network ..... 5-way male and unpluggable female connector (supplied)
Maximum cable size 2.5 mm2

Settings

Protocol ..... Modbus RTU, AP ASCII
Address range ..... 0 to 31
Data rate (bps) 4800, 9600, 19200, 38400
Parity ..... None, Odd, Even, 10-bit
Timeout ..... None (off), 10 s, 60 s, 100 s

Certification

C✓ ..... IEC 60947-4-2
CE ..... IEC 60947-4-2
RoHS ..... Compliant with EU Directive 2002/95/EC

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